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(54) ORTHOPEDIC DRILL GUIDE APPARATUS

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No. OF CLAIMS 14

BACKGROUND OF THE INVENTION

Field of the Invention:

The drill guide apparatus of present invention relates to a device for guiding a drill to drill a bore in a fractured bone or the like.

Description of the Prior Art:

In hip pinning operations, it has been common practice for orthopedic surgeons to obtain X-rays of a fractured trochanter and then estimate the desired location and angularity for the hip pin and then drill a series of guide bores in accordance with such estimation. Thereafter, additional X-rays are taken to determine the location of the guide bores and if such bores are not properly located, additional bores are drilled and further X-rays taken. Such a trial-and-error procedure is time consuming and expensive while subjecting the patient to extended operative risks and trauma.

Numerous hip pin guide devices have been proposed for insertion in a large incision formed along the upper femoral shaft to locate and maintain the desired angularity for a drill while drilling a bore down the axis of the trochanter. However, such devices are generally unsatisfactory because of the requirement of a large incision and the additional risk of infection and trauma.

In the early 30's a rather cumbersome drill guide was proposed which mounted directly on the fracture table. This device is described in an article by Sven Johansson published in the Scandinavian orthopedic journal entitled ACTA ORTHO SCAND 3, 1932. A large cumbersome apparatus of this type suffers the shortcoming that it is cumbersome to use and hinders access to the fracture site. Further, such devices are difficult to sterilize and raise the risk of contamination.

SUMMARY OF THE INVENTION

The orthopedic drill guide apparatus of present invention is characterized by a hand-held pistol device having aiming means mounted thereon for being aligned over a selected point on an X-ray image-producing target disposed over the fracture site. Guide means is mounted on the pistol device in alignment with the aiming means and an indicator is provided for indicating when the pistol device is oriented to align the guide means with the aiming means to thereby guide the drill directly along a line corresponding with the location and orientation of the aiming means.

The object and advantages of the present invention will become apparent from a consideration of the following detailed description when taken in conjunction with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view of a patient suffering a fractured trochanter which may have a bore drilled therein by a drill guide apparatus embodying the present invention;

FIG. 2 is a side elevational view of the patient shown in FIG. 1;

FIG. 3 is a diagrammatic view of an X-ray of the trochanter of the patient shown in FIG. 1;

FIG. 4 is a perspective view of a drill guide apparatus embodying the present invention;

FIG. 5 is a front view of an anteversion angle indicator which may be utilized with the drill guide apparatus shown in FIG. 4;

FIG. 6 is a top view, in reduced scale, of the drill guide apparatus shown in FIG. 4 being utilized to guide a drill down the axis of a patient's trochanter;

FIG. 7 is a vertical sectional view taken along the line 7-7 of FIG. 6;

FIG. 8 is a perspective view of an aiming pin which may be utilized with the drill guide apparatus shown in FIG. 4;

FIG. 9 is a detailed view of a modification of the drill guide apparatus shown in FIG. 4;

FIG. 10 is a vertical sectional view taken along the line 10-10 of FIG. 9;

FIG. 11 is a vertical sectional view taken through a patient's hip and showing the drill guide apparatus shown in FIG. 4 being utilized to guide a bone drill;

FIG. 12 is a vertical sectional view, in enlarged scale, taken along the line 12-12 of FIG. 11;

FIG. 13 is a schematic view of a patient's trochanter which has had hip pins inserted by means of the drill guide apparatus shown in FIG. 4;

FIG. 14 is a front view of a second modification of the drill guide apparatus shown in FIG. 1;

FIG. 15 is a partial front view of a third modification of the drill guide apparatus shown in FIG. 1;

FIG. 16 is a perspective view of a fixed shank hip pin guide which may be used with the drill guide shown in FIG. 4;

FIG. 17 is a front view of the drill guide shown in FIG. 16;

FIG. 18 is a vertical sectional view, in enlarged scale, taken along the line 18-18 of FIG. 17;

FIG. 19 is a schematic view of an X-ray having the fixed shank drill guide shown in FIG. 16 disposed thereover; and

FIG. 20 is a front view of a fixed shank hip pin.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 4, 6 and 7, the drill guide apparatus of present invention includes, generally, a pistol device in the form of an inverted L-shaped member 31 having an aiming pin 33 mounted on the barrel thereof and a through vertically extending drill guide slot 35 formed in the vertical leg thereof. Suspended beneath the barrel of the pistol device 31 is a pendulum type transverse indicator 41 for indicating the transverse inclination of such pistol device. Thus, a metallic target, generally designated 43, (FIG. 6) may be placed over a patient's groin area near a fractured trochanter and the aiming pin 33 aligned over a selected point on such target and the pistol device 31 rotated about its longitudinal axis until the vertical indicator 41 indicates the drill guide slot 35 is aligned directly below the aiming pin 33 for receipt of the bone drill 47 to maintain such drill in the vertical plan of the aiming pin 33.

Referring to FIG. 4, the pistol device 31 is formed with a longitudinally extending barrel 51 which is formed in its upper extremity with a longitudinally extending upwardly opening groove 53 for receipt of the aiming pin 33. A thumb screw 55 is screwed into a threaded transverse bore thereby such screw may be tightened against the aiming pin 33 to hold it in position. The pistol device 31 further includes a downwardly projecting vertical leg 57 which has an extension 59 telescoped upwardly over the lower end thereof. The extension 59 is formed with an upwardly opening passage 61 for receipt of the lower extremity of the vertical leg 57. A thumb screw 63 is screwed into a threaded bore formed in the extension 59 to be screwed inwardly against the vertical leg 57 to hold the extension 59 in fixed telescopical relationship

with respect thereto.

The transverse indicator 41 is suspended beneath the barrel 41 by means of a pivot pin 67 for free rotation thereof.

A longitudinal indicator in the form of a pendulum type pointer, generally designated 71, is mounted on the side of the pistol device 31 by means of a pivot pin 73 and is formed with a downwardly projecting weight 75 and an upwardly projecting pointer 77 which points to a vertical indicator line 81 to indicate the longitudinal inclination of such pistol device.

The target 43 is constructed from a somewhat resilient, heavy metallic wire and is formed with a plurality of longitudinally spaced shaped elements 85 which are all of a different configuration so each one can be easily identified on an X-ray. The spaced elements 85 included in the target 43 shown in FIG. 6, are in the form of turned-back loops to form a somewhat sckewed sign wave having the spaces of the individual elements disposed at one inch spacings from one another. The opposite ends of the target 43 terminate in closed cells forming respective holding loops 87 which may conveniently receive towel clips 89 for clipping the target 43 to the patient's skin or draping to thereby maintain such targets securely in position.

In operation, when the drill guide apparatus of present invention is to be utilized for drilling a bore in a fractured trochanter 45, the patient is placed on his back on a fracture table 91 and the patients rendered immobile and secured in position by conventional traction devices or the like. The target 43 is then positioned over the injured trochanter and arranged to extend generally transverse to the axis 95 (FIG. 3) of the injured trochanter 45 and is pinned in place by the towel clips 89. An X-ray camera 97 is mounted from a vertical

post 99 to be closely held in a horizontal plane and such camera is moved into position over the trochanter area and an anterior-posterior picture taken to produce an anterior-posterior X-ray 101 as shown in FIG. 3. The surgeon will then review the X-ray 101 to determine that the extended axis 95 of the trochanter 45 intersects the image of the target 43 at a point 109 formed by the lower portion of the shaped element 65 disposed third from the top end of such target 43.

The axis of the trochanter normally extends at an angle between 10 and 30 degrees from the horizontal when the patient is lying on his back as shown in FIG. 1. This angle is normally referred to as the angle of anteversion. It is common practice to obtain an estimate of the angle of anteversion by taking a lateral X-ray looking inwardly from the side of the patient and then viewing the X-ray to obtain an estimate of the angle of anteversion. The drill 47 would then be held at the estimated angle in order to follow the axis of the trochanter.

The surgeon will then loosen the thumb screw 55 to adjust the aiming pin 53 in the passage 53 such that the projecting extremity projects over the target 43. The surgeon will then align the aiming pin 53 over the point 111 on the target 43 which corresponds with the point 109 on the image 105. While maintaining this alignment and holding the pistol device 51 to maintain the aiming pin 53 generally aligned over the axis 95 of the trochanter, the surgeon will rotate such pistol device about the aiming pin 59 until the transverse indicator 91 hangs directly downwardly along the front side of the vertical leg 57 to thereby assure that the drill guide slot 93 is aligned vertically under such aiming pin 53. The bone drill 47 may then be inserted through the drill slot 93 and into a puncture wound made in alignment with the axis 95 of the

trochanter 45 to drill a bore that is aligned directly below the aiming pin 33. The elongated vertical slot 35 enables the vertical location of the drill 47 to be easily adjusted and the estimated angle of anteversion to be held.

I have provided an anteversion indicator, generally designated 121, as shown in FIGS. 5, 6 and 7 for accurately holding the angle of anteversion during drilling. The anteversion indicator 121 is in the form of a base plate 123 having a series of bores 125 formed through the upper extremity thereof for receipt of different sized bone drills 47. Disposed on the front of the plate 123 is a pendulum pointer 127 carried from a pivot pin 129. The angle marks 131 are scribed on the front of the plate 123 for indicating the inclination of the anteversion indicator 121. Consequently, in use if the angle of anteversion is determined to be 10 degrees the drill is inserted through one of the bores 125 and then through the drill guide slot 35 as shown in FIG. 7. The drill 47 will then be held at the indicated anteversion angle of 10 degrees while the bore is drilled in the trochanter 45.

An extension, generally designated 133, which may be substituted for the extension 39 is shown in FIG. 9. The extension 133 includes a through longitudinal slot 137 for receipt of a guide disc 139. Formed in the walls of the extension 133 on opposite sides of the slot 137 are a pair of vertically extending slots defining tracks 141 for receipt of respective hubs 143 projecting from opposite sides of the disc 139. The disc 139 includes a plurality of radially extending diametrical drill guide bores 145 of different diameters as shown in FIG. 10. A series of angle indication marks 147 are scribed on the extension 133 and radially extending lines 149 are drawn on the side of the disc 139 in alignment with the

respective bores 145 for cooperation with the marks 147 to determine if the angle at which a drill extending through one of the bores 145 is projecting.

Consequently, when the extension 137 is utilized with the pistol device 31, the drill 47 may be inserted through the bore 145 of the appropriate size and with the pistol device oriented to have the aiming pin 33 extending horizontally as indicated by the longitudinal indicator 71, the angle of the drill projecting from one of the bores 145 may be determined by noting the degree line 147 with which the line 149 corresponding to the bore 145 through which the drill extends is aligned.

Referring to FIGS. 11 and 12, a drill jig, generally designated 151, is provided with a plurality of spaced apart parallel extending guide bores 153 whereby a bore may be drilled in the trochanter 45 and a pin 155 inserted therein with a portion of such pin projecting for receipt in one of the bores 153 in the jig 151. With this arrangement, additional bores may be drilled in the trochanter 45 in spaced apart relationship and projecting parallel to the pin 155 by merely inserting the drill in different bores 153 and using such bores as a guide for drilling bores in the trochanter for receipt of additional pins to thereby enable installation of a plurality of parallel pins 155 as shown in FIG. 13.

The drill guide apparatus shown in FIG. 14 is similar to FIG. 4 except that the pistol device 31 includes a vertical extension 161 which has the lower end thereof angled inwardly to complement the shape of the patient's hip.

The extension, generally designated 165, shown in FIG. 15, is similar to the extension 39 except that it is formed with

e longitudinally extending through slot which slidably receives an arm 167 that carries a guide disc 139 on the lower extremity thereof. Extending longitudinally through the arm 167 is a threaded brake rod which terminates at its upper end in a thumb screw head 171. Consequently, the guide disc 139 may be set at a particular setting and the brake 171 tightened to hold such disc 139 locked in the desired position.

Referring to FIGS. 18-20, a fixed shank hip pin guide, generally designated 175, is provided for holding the angularity of a drill while drilling a bore for receipt of a fixed shank hip pin, generally designated 176, as shown in FIG. 20. The guide 175 includes a barrel 177 having a side opening longitudinal slot 179 formed therein for receipt of the guide pin 33. Thumb screws 183 are provided for tightening the aiming pin 33 in place. Extending at an angle of approximately 135 degrees to the barrel 177 is a leg 187 which has a transverse bore 191 formed therein for receipt of an indexing pin 193.

The fixed flange hip pin 176 includes a nail 195 that extends at an angle of 135 degrees from the flange 197.

Installation of the hip pin 176 is similar to installation of the aforementioned hip pin except that a second target 43' is laid over the injured groin area prior to the taking of the anterior-posterior X-ray to produce an X-ray image similar to that shown in FIG. 19. The aiming pin 33 is again positioned over the X-ray to extend along the trochanter axis and the flange 197 of the guide 175 is laid along the lateral side of the femoral shaft 201. The point at which aiming pin 33 intersects the image of the target 43 is then marked, as is the point at which the index pin 193 intersects the target 43'. The guide 175 is then positioned

over the patient's hip and oriented to cause the aiming pin 33 and index pin 199 to intersect the targets 43 and 43' at the respective points corresponding with those marked on the X-ray. The passage 53 of the guide apparatus 31 may then be inserted over the rear extremity of the aiming pin 33 and such pistol device rotated to align the transverse indicator 41 with the leg 57 to position the guide slot 35 directly below the aiming pin 33.

A lateral incision may be made along side the upper femoral shaft 201 and a drill 47 inserted through an anteversion angle indicator 121 and through the slot 35 to drill the desired bore in the trochanter. The drill 47 may then be removed and the nail 195 of the pin 176 inserted in the resultant bore, it being realised that the shank 197 will then be disposed at the required angle to lie along the lateral surface of the femoral shaft 201. Screws may be inserted through the shanks 197 to hold the pin in place.

While the procedures described hereinabove drastically reduce the number of X-rays that must be taken during a pinning operation, it will be appreciated that X-rays may be taken after the operation to confirm the proper location of the pin installed.

From the foregoing it will be apparent that the drill guide apparatus of present invention provides an economical and convenient means for drilling a bore at a desired location in a trochanter or the like. The bore may easily be located without the necessity of trial and error drilling and the taking of numerous X-rays thereby substantially reducing the cost of operation and also the operating time thereby reducing the risk of contamination and the patient trauma.

Various modifications and changes may be made with regard to the foregoing detailed description without departing from the spirit of the invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. Orthopedic drill guide apparatus for use in drilling a bore in a bone and comprising:

an X-ray image-producing target for placement exteriorly on said patient adjacent said bone;

a portable pistol device

aiming means mounted on the top of said pistol device for alignment with said target;

drill guide means mounted on said pistol device and disposed below said aiming means;

transverse indicator means for indicating the transverse inclination of said pistol device whereby said target may be placed exteriorly on a patient adjacent said bone, an X-ray machine oriented in a selected plane over said bone and aimed at said target and said bone, an X-ray picture taken, a target point selected on the image of said target, said aiming means aimed at the corresponding target point and said pistol device maneuvered about while said aiming means is held on said corresponding target spot until said transverse indicator means indicates said aiming means and guide means are in a plane perpendicular to the plane of said X-ray machine, a drill extended through said drill guide means and a bore drilled in said bone.

2. Orthopedic drill guide apparatus as set forth in Claim 1 wherein:

said drill guide means is in the form of an elongated guide slot for receiving said drill.

3. Orthopedic drill guide apparatus as set forth in Claim 1 wherein:

said aiming means includes an elongated guide pin projecting from said pistol device for having its projecting

extremity aligned over said target.

4. Orthopedic drill guide apparatus as set forth in Claim 1 wherein:

said target includes a plurality of different shaped figures disposed at selected distances from one another.

5. Orthopedic drill guide apparatus as set forth in Claim 1 wherein:

said indicator means is in the form of pendulum means.

6. Orthopedic drill guide apparatus as set forth in Claim 1 wherein:

said pistol device is in the form of an inverted L-shaped element;

said aiming means includes an aiming pin projecting from the horizontal leg of said pistol device.

7. Orthopedic drill guide apparatus as set forth in Claim 1 wherein:

said drill guide means includes a guide disc rotatably mounted on said pistol device and including a plurality of radially projecting through guide passages of different cross sections.

8. Orthopedic drill guide apparatus as set forth in Claim 1 that includes:

a drill jig including a plurality of parallel drill passages whereby said drill may be inserted through said drill guide means to drill a first bore in said bone, one end of a pin inserted in said first bore with the opposite extremity projecting therefrom, said jig installed on said pin by inserting said extremity in one of said drill passages and said drill inserted in other of said drill passages to drill bores parallel to said first bore.

9. Orthopedic drill guide apparatus as set forth in Claim 1 that includes:

longitudinal indicator means on said pistol device for indicating the longitudinal inclination of said pistol device and wherein;

said guide means includes indicia for indicating the angle of anteversion of said drill.

10. Orthopedic drill guide apparatus as set forth in Claim 1 wherein:

said pistol device is formed with a horizontally projecting portion having said aiming means mounted thereon and a vertically projecting portion having said guide means mounted thereon said device, further including a telescoping means interconnecting said horizontal section and said vertical section.

11. Orthopedic drill guide apparatus as set forth in Claim 1 that includes:

a fixed shank guide for use with a fixed shank hip pin having a nail and a shank projecting therefrom at a selected angle, said fixed shank guide including trochanteral aiming means, a shank portion projecting at said selected angle from said trochanteral aiming means, said fixed shank guide further including angular index means extending at an angle to said trochanteral means whereby said target may be positioned over a fractured trochantor, an X-ray taken thereof, said fixed shank guide arranged on said X-ray with said shank portion extending along the image of the femoral shaft and said trochanteral aiming means projecting along the image of the neck of said trochanter to enable the user to obtain points on said target corresponding with the intersection thereof of said trochanteral aiming means and said index means so

said fixed chank guide can be transferred to the patient with said trochanteral aiming means and index means aligned with corresponding points on said target and said first mentioned aiming means aligned with said trochanteral aiming means to locate said drill guide means for receipt of said drill.

12. Orthopedic drill guide apparatus as set forth in Claim 1 wherein:

said pistol device is formed with an elongated track projecting transversely to said aiming means; and

said drill guide is received for longitudinal sliding in said track and includes a plurality of different sized through passages for receipt of different sized drills.

13. Orthopedic drill guide apparatus as set forth in Claim 1 that includes:

an anteversion angle indicator including a base plate formed with a drill passage therethrough and anteversion inclination indicator means mounted on said plate.

14. Orthopedic drill guide apparatus as set forth in Claim 3 wherein:

said pistol device includes an elongated passage for telescopical receipt of said pin and tightening means for tightening said guide pin in position.

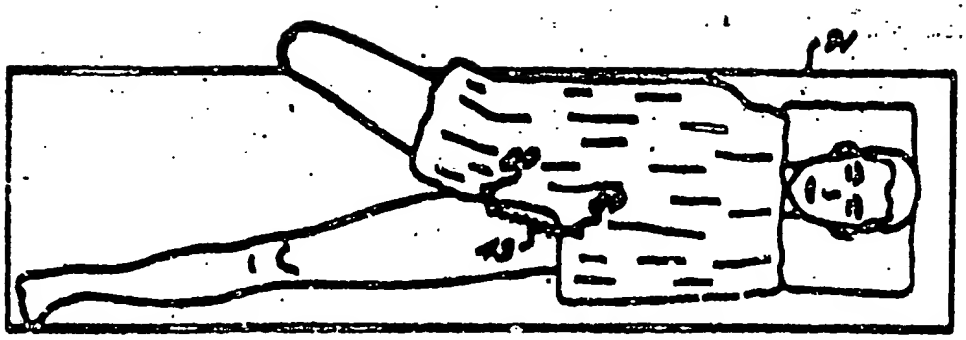


FIG.1

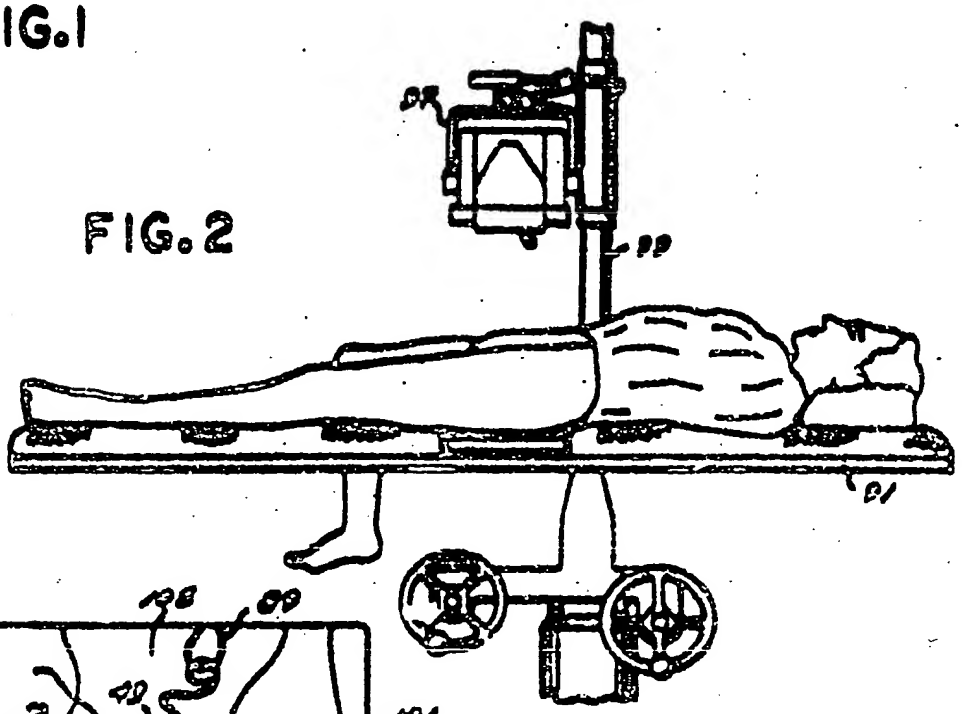


FIG.2

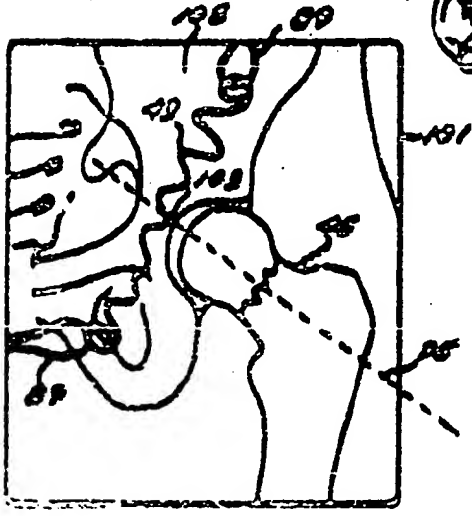


FIG.3

FIG.4

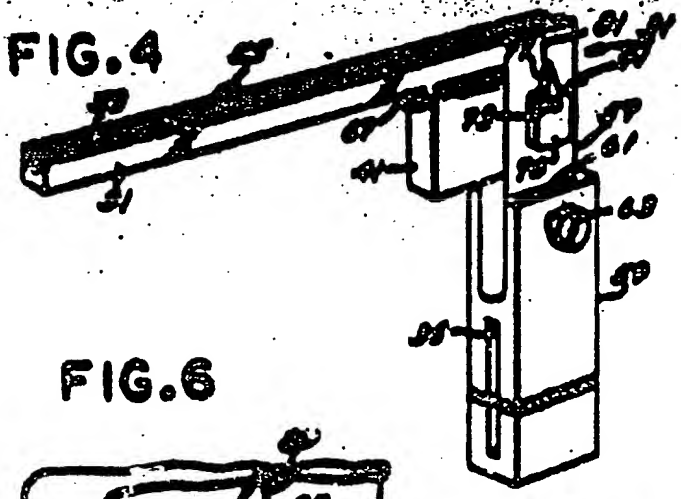


FIG.5

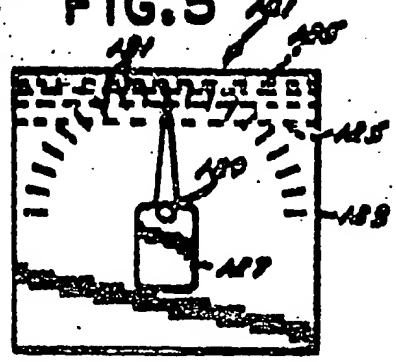


FIG.6

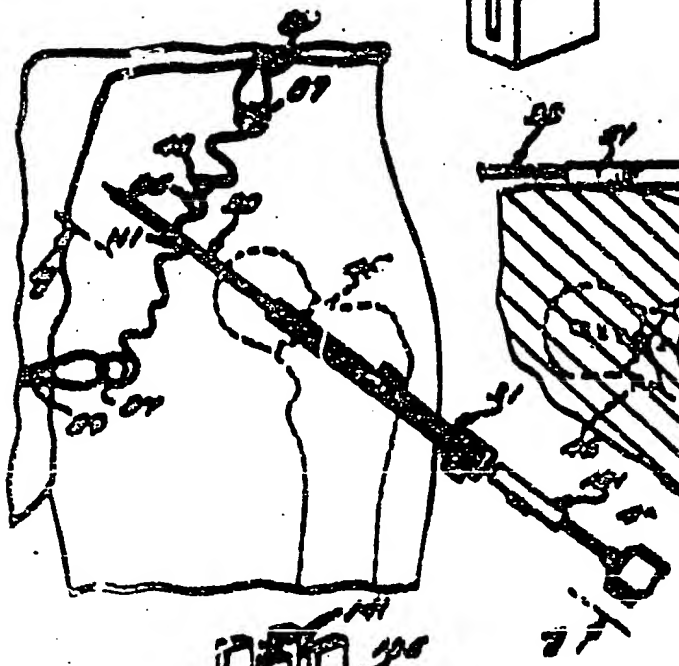


FIG.7

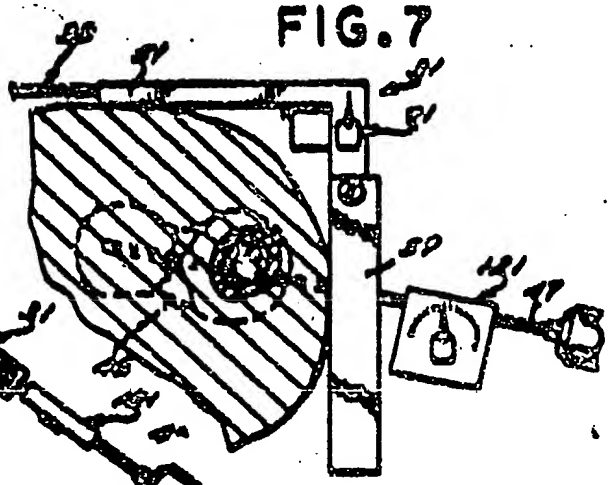


FIG.9

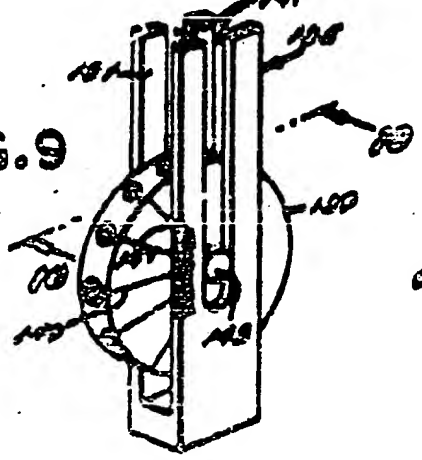


FIG.8

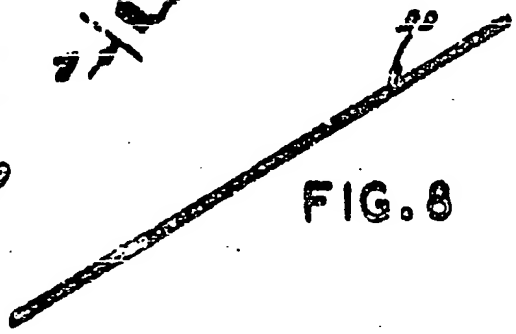


FIG.10

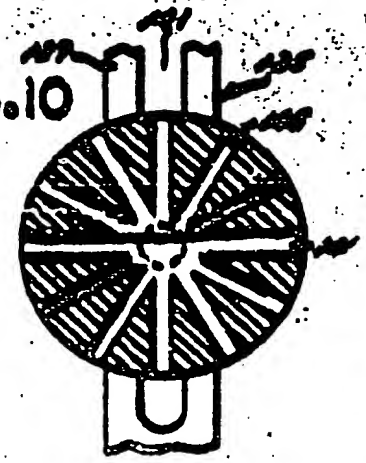


FIG.11

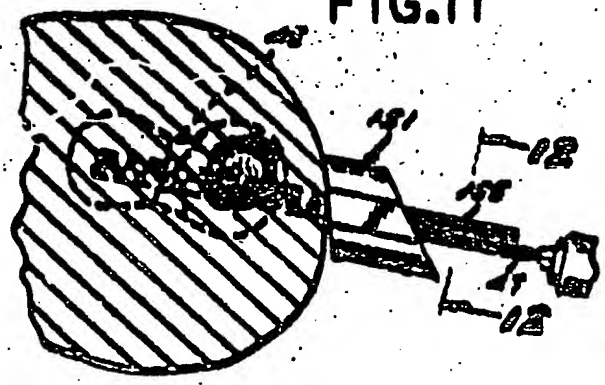


FIG.12

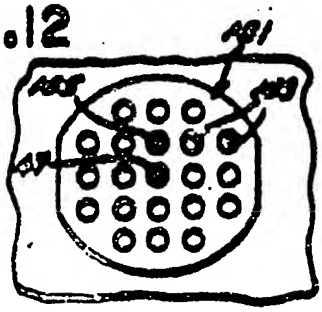


FIG.14

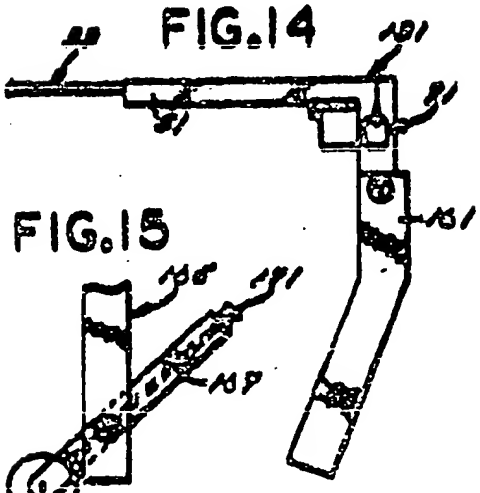


FIG.15

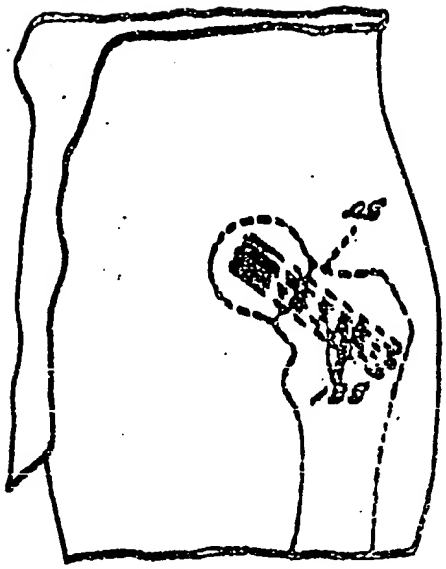


FIG.13

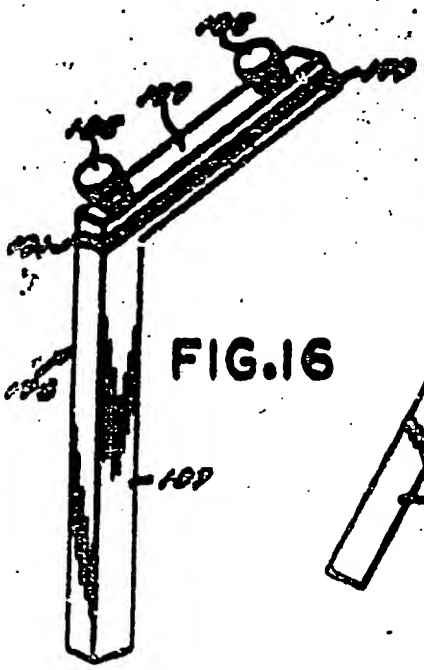


FIG.16

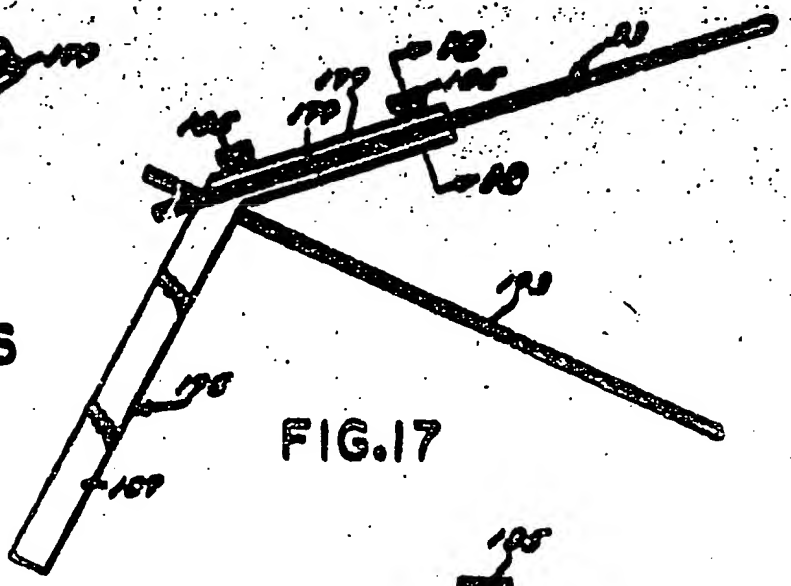


FIG.17

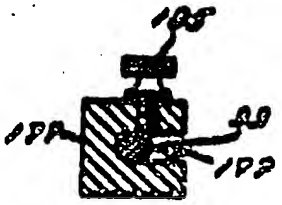
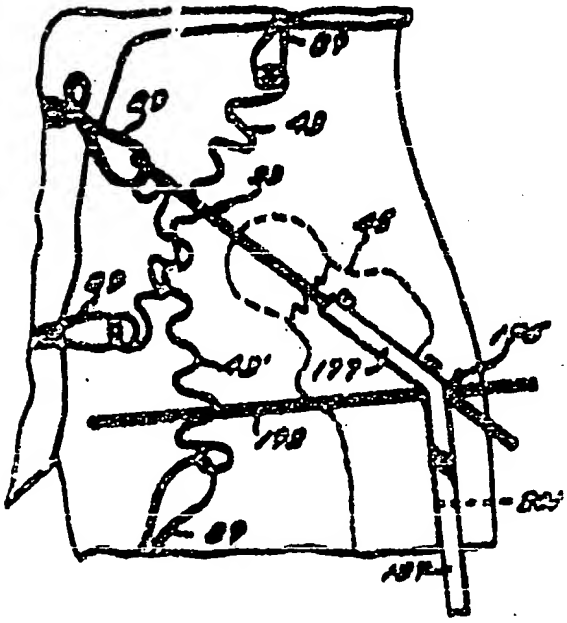


FIG.18

FIG.19



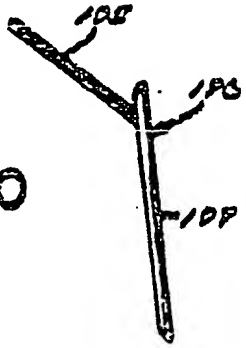


FIG.20